Old Dominion University
Department of Physics

Colloquium

Thursday, March 31, 2022

"What are hadrons made of? Parton structure on the lattice"

Dr. Joseph Karpie
Columbia University

Abstract:

The vast majority of the mass of the visible universe consists of hadrons, specifically the nucleons and nuclei. These hadrons are emergent properties of Quantum ChromoDynamics (QCD), the quantum theory of quarks and gluons, but their description in terms of those constituent particles, called collectively partons, is hidden by the strong interactions at low energies. High energy experiments, such as those at Jefferson Lab, the Large Hadron Collider, and the future Electron Ion Collider, have seek to probe the internal structure of nucleons and nuclei. Combined global analysis of these experiments have led to determination of an universal description of how different partons are distributed within the various hadrons. Until the past decade, a first-principles calculation of these parton distributions was hindered by their non-perturbative nature. I will describe a method, called the pseudo-PDF approach, which relates objects calculated with non-perturbative lattice QCD to the desired parton distributions of quark and gluons. Over the past 5 years, this approach has matured to the point where systematic errors must be considered seriously. I will demonstrate a general method for removing their effects in a simultaneous analysis of lattice QCD data. Finally, I will show the efficacy of combining lattice and experimental results both for improving the overall final PDF determination as well as constraining the systematic errors of the lattice calculation.

Dr. Joseph Karpie
March 31, 2022
3:00 PM

"What are hadrons made of: Parton structure on the lattice"

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All interested persons are cordially invited to attend